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UPDATE OF THE FISHERY INDICATORS FOR ROCK CRAB (*CANCER IRRORATUS*) IN THE SOUTHERN GULF OF ST. LAWRENCE

Context

The most recent assessment for the rock crab fishery of the southern Gulf of St. Lawrence (sGSL) was completed in 2013 with information up to 2011 (DFO 2013; Rondeau et al. 2014). The next complete assessment for the fishery is scheduled for 2018. The update of the fishery status indicators was requested by DFO Gulf Region Fisheries and Aquaculture Management (FAM). This Science Response report results from the Science Response Process of November 14, 2016, on the Update to 2016 of the indicators of the American lobster (*Homarus americanus*) and the rock crab (*Cancer irroratus*) stocks of the southern Gulf of St. Lawrence.

Background

The rock crab fishery in the sGSL (Fig. 1) is comprised of three distinct components: the bycatch fishery, the bait fishery, and the directed fishery. The bycatch and bait fisheries are conducted during the lobster fishery by lobster licence holders. The directed fishery is conducted at a different time by rock crab licence holders.

The management of the directed rock crab fishery is based on effort control (number of licences, individual trap allocation, restrictions on gear characteristics, and limited fishing seasons), with individual catch allocations (only since 2015 in Lobster Fishing Area (LFA) 24), and a minimum legal size. The individual allocations are not based on stock status or biomass estimates. Females cannot be landed and all rock crab landings from the directed fishery are verified through a dockside monitoring program (DMP). For the directed fishery, logbooks are mandatory and must record daily catch, effort, and fishing locations.

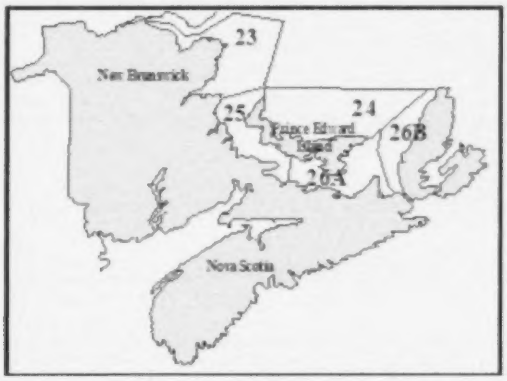

Figure 1. Lobster Fishing Areas (LFA) used in the management of the directed rock crab fishery in the southern Gulf of St. Lawrence.

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Analysis and Response

This update was mostly based on fishery-dependent indicators including landings, catch per unit effort, and the percentage of licence holders reaching their individual allocation based on information recorded in logbook reports, DMP records, and licence type statistics. Since the last assessment, no trawl or trap survey was conducted to gather fishery-independent data. The only available fishery-independent indicator is the industry-led bio-collectors study around Prince Edward Island from which a rock crab settlement index was derived for the years 2008 and 2016. Although the bio-collectors were originally designed to monitor lobster settlement, they were also efficient in collecting rock crab settlers and provided the only data for early rock crab benthic stages. Data on bycatch of rock crab during the lobster fishery were obtained from sales transactions from DFO Statistics.

Fishery-dependent indicators

Total fishery landings

Prior to 2000, rock crab landings were not partitioned by fishery type, directed and bycatch. Since 2007, landings from the directed fishery show a declining trend. From the 2015 preliminary data, 3,072 t of rock crab were landed during the directed fishery representing a 27% decrease from 2011 (4,195 t). Landings of rock crab as a bycatch during the lobster fishery have also declined steadily since 2004 with 76 t reported in 2015 (Fig. 2).

Figure 2. Recorded rock crab landings (t) from the directed fisheries, the bycatch fisheries, and the fisheries combined in the southern Gulf of St. Lawrence, 1985 to 2015. Prior to 2000, no distinction was made between directed and bycatch landings origin. Data for 2015 are preliminary.

Directed fishery landings

While landings from the directed fishery were relatively stable between 2004 and 2011, a decline was observed since 2012 with landings declining to approximately 3,000 t in 2015 (Table 1). Landings overall and in individual LFAs recorded between 2012 and 2015 were the lowest of the time series. Most landings are still recorded from LFAs 26A and 25 but a 15% and

36% decrease in landings between 2011 and 2015 were observed in those LFAs respectively. In LFA 23, the 2015 preliminary landings of 636 t are 17% lower than in 2011. A total of 49 t of rock crab were landed in 2015 by the six active licence holders in LFA 24, representing a 74% decrease from 2011. The fishery in LFA 24 changed in 2015 with 15 temporary licences replaced by 10 commercial licences and the implementation of an individual allocation of 20,000 kg. In 2012, landings were around 1 t in LFA 26B, and no landings have been recorded since (Table 1).

Table 1. Recorded rock crab landings (t) by Lobster Fishing Area and overall from the directed fishery, 2000 to 2015. Data for 2015 are preliminary.

Year	LFA 23	LFA 24	LFA 25	LFA 26A	LFA 26B	Total
2000	995	237	1,186	1,917	24	4,360
2001	1,128	211	1,300	2,063	25	4,727
2002	1,007	177	1,378	1,769	18	4,349
2003	665	136	1,284	1,592	8	3,685
2004	956	183	1,290	1,591	21	4,041
2005	1,028	159	1,469	1,867	29	4,552
2006	982	212	1,361	1,574	43	4,172
2007	957	221	1,551	1,796	24	4,550
2008	846	181	1,687	1,685	18	4,417
2009	1,051	162	1,568	1,477	17	4,274
2010	817	167	1,578	1,624	1	4,187
2011	764	187	1,510	1,731	4	4,195
2012	534	139	1,474	1,504	1	3,653
2013	542	155	1,416	1,422	0	3,536
2014	448	88	1,171	1,552	0	3,259
2015	636	49	1,281	1,106	0	3,072

Considering all licences issued with their respective allocations, there is potential for increased rock crab harvest throughout the sGSL from the directed fishery. The 2015 preliminary landings of 3,072 t represented only 49% (Table 2) of the total allocation (6,277 t).

Table 2. Percentages of the total allocation of rock crab landed in the directed fishery by Lobster Fishing Area and overall, 2006 to 2015. Data for 2015 are preliminary.

Year	LFA 23	LFA 24	LFA 25	LFA 26A	LFA 26B	Total
2006	51%	na	69%	69%	13%	61%
2007	50%	na	80%	79%	7%	67%
2008	44%	na	85%	74%	6%	65%
2009	55%	na	79%	65%	6%	63%
2010	42%	na	79%	72%	1%	65%
2011	40%	na	76%	76%	1%	65%
2012	28%	na	74%	66%	1%	57%
2013	29%	na	73%	61%	0%	55%
2014	24%	na	59%	63%	0%	49%
2015	35%	25%	67%	51%	0%	49%

Directed fishery effort

As for landings, the number of recorded fishing trips declined in the past six years, reaching a historical low of 2,608 trips in 2014. The 2,670 trips recorded in 2015 represent a 15% drop compared to the 3,154 trips recorded in 2011 (Table 3). As mentioned previously, no fishing activity has been recorded in LFA 26B since 2013 while only three trips were recorded in 2012 (Table 3). The decrease in fishing trips between 2011 and 2015 ranged from 12% to 17% in

LFAs 23, 25, and 26A while the drop was more pronounced in LFA 24 with a decline of 52%. The declining trends in landings and number of trips are very similar.

Table 3. Number of recorded fishing trips in the directed rock crab fishery by Lobster Fishing Area and overall, 2000 to 2015. Data for 2015 are preliminary.

Year	LFA 23	LFA 24	LFA 25	LFA 26A	LFA 26B	Total
2000	1,497	400	1,100	1,795	68	4,860
2001	1,556	335	1,355	2,159	82	5,487
2002	1,397	257	1,173	1,633	47	4,507
2003	637	178	1,102	1,341	19	3,277
2004	1,018	139	1,176	1,612	38	3,983
2005	1,063	166	1,138	1,276	49	3,692
2006	1,015	220	1,305	1,482	83	4,105
2007	993	211	1,277	1,349	66	3,896
2008	927	137	1,266	1,294	29	3,653
2009	924	167	1,256	1,422	30	3,799
2010	747	140	1,145	1,255	2	3,289
2011	662	161	1,093	1,231	7	3,154
2012	564	157	1,057	1,190	3	2,971
2013	511	195	1,042	1,155	0	2,903
2014	454	129	954	1,071	0	2,608
2015	551	78	967	1,074	0	2,670

Fishing effort distribution based on logbook data did not appear to have changed over the last years but only limited analyses can be done. In 2015, out of 2,670 trips recorded, only 888 had useable fishing position information. Several logbook entries had no fishing positions while others were recorded in an improper format.

Directed fishery catch rate

Different trends were observed among LFAs based on the preliminary catch rates. In LFA 23, the mean annual catch rate of 12.3 kg per trap in 2015 (Table 4) was one of the highest of the time series but there were large variations in recent years with no clear trend. Similarly, the 2015 catch rate of 14.5 kg per trap was the highest value observed in LFA 25 since 2000. Catch rates have been declining steadily since 2010 in LFA 24 and reached its lowest value in 2015 at 5.3 kg per trap (Table 4). In LFA 26A, catch rates have been fluctuating with no clear trend throughout the time series, however, the 2014 and 2015 mean annual values were among the highest and lowest respectively (Table 4). The catch rate trend in LFA 26B cannot be updated as there has not been any recorded fishing activity since 2013.

Table 4. Annual catch rate (kg per trap; mean and 95% confidence interval range) of rock crab in the directed fishery by Lobster Fishing Area from 2000 to 2015. Data for 2015 are preliminary.

Year	LFA 23	LFA 24	LFA 25	LFA 26A	LFA 26B
2000	7.5 (0.3)	6.1 (0.5)	11.2 (0.4)	13.2 (0.3)	4.4 (0.6)
2001	7.8 (0.3)	5.8 (0.5)	10.6 (0.7)	11.6 (0.3)	4.3 (0.8)
2002	8.0 (0.3)	6.7 (0.5)	12.2 (0.4)	13.7 (1.4)	5.5 (1.0)
2003	12.5 (0.5)	7.8 (0.6)	12.7 (0.4)	14.1 (0.4)	5.4 (1.2)
2004	10.8 (0.3)	10.2 (0.7)	12.1 (0.4)	11.6 (0.2)	9.5 (1.1)
2005	10.6 (0.3)	10.1 (0.8)	14.1 (0.6)	17.3 (0.6)	9.8 (1.2)
2006	9.9 (0.3)	10.6 (0.7)	11.3 (0.3)	12.2 (0.3)	6.1 (0.6)
2007	10.3 (0.4)	8.3 (0.6)	12.6 (0.3)	15.0 (0.4)	4.6 (0.6)
2008	10.8 (0.7)	9.5 (0.6)	13.9 (0.4)	15.4 (0.6)	7.3 (1.1)
2009	12.5 (0.4)	7.8 (0.5)	12.5 (0.3)	11.9 (0.2)	6.5 (0.7)
2010	11.9 (0.4)	9.8 (0.9)	14.3 (0.5)	15.1 (0.4)	8.4 (0.7)
2011	12.1 (0.5)	9.2 (0.5)	14.2 (0.4)	16.3 (0.4)	10.6 (4.0)

Year	LFA 23	LFA 24	LFA 25	LFA 26A	LFA 26B
2012	9.8 (0.4)	7.2 (0.5)	13.9 (0.4)	14.4 (0.3)	5.9 (1.8)
2013	11.1 (0.5)	6.8 (0.4)	14.0 (0.4)	14.0 (0.4)	na
2014	11.1 (0.5)	6.6 (0.6)	13.6 (0.4)	17.5 (0.5)	na
2015	12.3 (0.5)	5.3 (0.5)	14.5 (0.4)	11.9 (0.4)	na

Attainment of individual allocation in the directed fishery

Consistent with the last assessment, no trend was observed in the percentages of active licence holders reaching 90% or more of their individual allocation. Despite a decrease in the number of active licence holders in LFA 26A (from 84 in 2011 to 72 in 2015), only 31% landed their entire allocation in 2015 (Table 5). This low percentage attainment may be attributable to preliminary and incomplete data. The number of active licence holders has also decreased in LFA 25 since the last assessment (from 68 to 56) but the percentage of active licence holders reaching their allocation remained fairly stable with a value of 59% in 2015 (Table 5). Values have fluctuated in LFA 23 but reached its highest percentage in 2015 with 37% of active licence holders reaching their allocation. The number of active licence holders declined from 42 in 2011 to 27 in 2015 in that LFA and this could explain the increased catches of those still fishing. An individual allocation of 20,000 kg was introduced in 2015 for LFA 24 and was based on average landings in the previous years. Six licence holders were active in 2015 and only one fished its entire allocation. A large amount of latent effort remains in this fishery.

Table 5. Percentages of active licence holders by Lobster Fishing Area which recorded landings of at least 90% of their individual allocation from 2006 to 2015. Data for 2015 are preliminary. Individual allocation implemented in 2015 for LFA 24; no fishing activities recorded in 26B since 2013.

Year	LFA 23	LFA 24	LFA 25	LFA 26A	LFA 26B
2006	30%	na	40%	59%	0%
2007	23%	na	64%	73%	0%
2008	21%	na	64%	69%	0%
2009	33%	na	51%	40%	0%
2010	26%	na	58%	60%	0%
2011	19%	na	53%	70%	0%
2012	12%	na	50%	48%	0%
2013	35%	na	55%	50%	na
2014	22%	na	42%	69%	na
2015	37%	17%	59%	31%	na

Bycatch fishery

Bycatch landings (sold, not personal use) of rock crab during the lobster fishery have greatly decreased in all LFAs since the last assessment (Table 6). In total, 76 t of rock crab were sold in 2015 compared to 328 t in 2011, a 4-fold decrease. In 2014 and 2015, there were no recorded rock crab sale transactions during the lobster fishery in LFAs 23 and 26B, and only two transactions in LFA 24 in 2015. The proportion of bycatch landings compared to landings from the directed fishery has also decreased from 8% in 2011 to 2% in 2015 (Table 6). Given that all lobster licence holders (2,931 in 2015) can land rock crab as bycatch, only 4% of the lobster licence holders reported doing so in 2015 compared to 13% in 2011. There is no estimate of the quantity of rock crab caught and used as bait during the lobster fishery.

Table 6. Rock crab landings (t) as bycatch during the lobster fishery by Lobster Fishing Area and overall, 2000 to 2015. Data for 2014 and 2015 are preliminary.

Year	LFA 23	LFA 24	LFA 25	LFA 26A	LFA 26B	Total Bycatch	% of Directed	Total Directed
2000	284	18	230	223	0	755	17%	4,360
2001	244	22	278	370	0	914	19%	4,727
2002	352	17	272	344	0	985	23%	4,349
2003	227	16	191	302	0	736	20%	3,685
2004	261	20	203	492	0	976	24%	4,041
2005	194	37	172	293	0	696	15%	4,552
2006	170	21	101	227	0	519	12%	4,172
2007	121	30	141	239	0	531	12%	4,550
2008	85	11	143	266	0	505	11%	4,417
2009	68	39	84	227	0	419	10%	4,274
2010	71	14	68	216	0	369	9%	4,187
2011	27	12	43	246	0	328	8%	4,196
2012	0	5	12	200	0	217	6%	3,653
2013	2	2	20	72	0	96	3%	3,536
2014	0	1	17	56	0	74	2%	3,259
2015	0	0	12	64	0	76	2%	3,072

Rock crab settlement index

The abundance of rock crabs < 16 mm carapace width estimated from the bio-collectors since 2009 showed contrasting patterns and abundance levels among sites and fishing areas. Since 2012, the abundance of rock crab has been very low (<0.5 crab per m²) to nil (Egmont Bay) in bio-collectors in central Northumberland Strait; part of LFAs 25 and 26A (Fig. 3). Decreasing trends and very low values have been observed for LFAs 25 and 26A outside of the Strait with a drop of 69% and 98% in Skinner's Pond and Murray Harbour, respectively, and an abundance near zero in Fortune. As observed in the previous assessment, the highest abundance values were observed at sites in LFA 24 with an average of approximately 70.0 crab per m^2. Inter-annual rock crab abundances also fluctuated significantly in both Alberton and Covehead (Fig. 3). Concentrations of rock crab settlers did not correlate with high fishing concentrations. The highest abundance values were observed in LFA 24 which has the second lowest rock crab fishing activity level. Conversely, the lowest to nil abundance of settlers were observed in the high fishing concentrations in central Northumberland Strait.

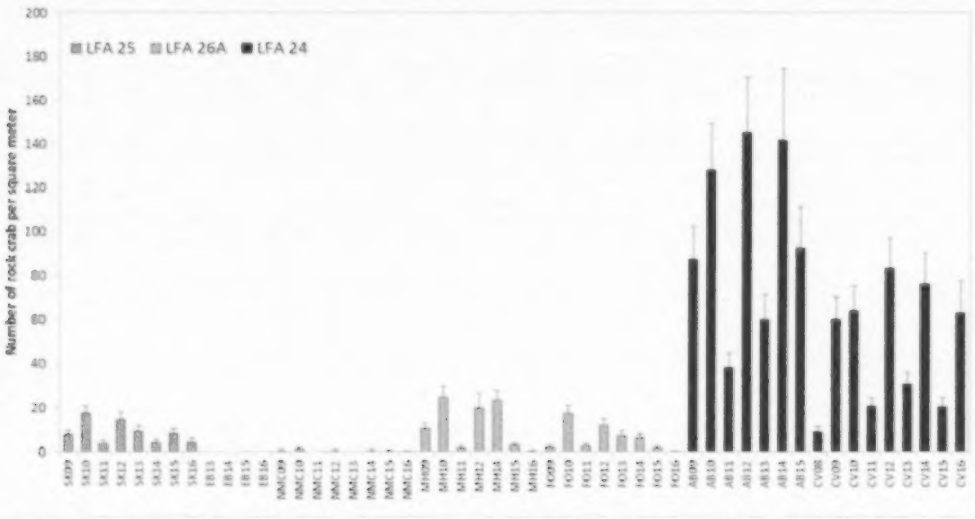

Figure 3. Number of rock crab <16 mm carapace width per square meter (mean and 95% C.I. error bars) enumerated from bio-collectors around Prince Edward Island since 2008. Site and year labels are interpreted as follows: AB = Alberton (no data in 2016), CV = Covehead, EB = Egmont Bay, FO = Fortune, MH = Murray Harbour, NMC = Nine Mile Creek, SK = Skinner's Pond, followed by the year (09 = 2009 to 16 = 2016).

Conclusions

Landings of rock crab from the directed fishery have decreased between 2011 and 2015, consistent with the decrease in the number of fishing trips. Catch rates varied in recent years according to the LFA, with high values in 2015 for LFAs 23 and 25 but in the lower range for LFAs 24 and 26A. Contrasting patterns have been observed from the rock crab settlement index, with very low abundance values in the highly fished areas (LFAs 25 and 26A) and the highest values in LFA 24 where directed fishing activities are marginal and catch rates are at their lowest.

Adjustments of escape mechanisms in lobster traps have most likely reduced the amount of rock crab retained and this could explain the decrease in recorded bycatch landings. The effect of this measure may vary among LFAs and is not quantified.

There is still a significant amount of latent fishing effort for rock crab in the directed, bycatch, and bait fisheries. Given the limited data and the lack of control over the quantity of rock crab that could be fished, assessing the impact of increased fishing pressure on the stock is not possible.

The assessment of the rock crab fishery relies on a very limited number of indicators that are all fishery-dependent. Fishery data are obtained through several unrelated processes that increase the chance of data errors and result in delays in data availability. It is paramount that information from mandatory logbooks is complete and accurate. Only preliminary data for 2015 were available for this update.

Most indicators used in the present assessment were derived from mandatory logbook data and official catch statistics from sale transactions. Observed variations in these indicators may not reflect changes in the rock crab abundance because catch and effort trends could have been influenced by management decisions and market demands. There are no estimates of total biomass or exploitation rates of rock crab in the sGSL. Landings are unlikely to be a proxy of

biomass because of individual allocations. Existing bottom trawl surveys do not provide useable indices for rock crab. Fishery-independent indicators are needed to properly assess the rock crab stock status.

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Sources of information

This Science Response report results from the Science Response Process of November 14, 2016 on the Update to 2016 of the indicators of the American lobster (*Homarus americanus*) and the rock crab (*Cancer irroratus*) stocks of the southern Gulf of St. Lawrence. No other publications are forthcoming from this process.

DFO. 2013. Assessment of the Rock Crab (*Cancer irroratus*) fishery in the southern Gulf of St. Lawrence for 2006 to 2011. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2013/030.

Rondeau, A., Hanson, J.M., and Comeau, M. 2014. Rock crab, *Cancer irroratus*, fishery and stock status in the southern Gulf of St. Lawrence: LFA 23, 24, 25, 26A and 26B. DFO Can. Sci. Advis. Sec. Res. Doc. 2014/032. vi + 52 p.

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